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Content

Game-Based Learning using Visual Spatial Approach for Children with Autism to Improve Social Development: A Pilot Study

Ilinadia Jamil[1,*], Fatrisha Mohamed Yussof[2], Nor Yus Shahirah Hassan[3], Azzureen Nor Ain Azizuddin[4] and Zainal Kadir[5]

[1-5]Department of Graphic and Digital Media, Faculty of Art and Design, Universiti Teknologi MARA, Melaka, Malaysia

*corresponding author: ilinadia@melaka.uitm.edu.my

***Abstract* - Autism is a disorder in the growth and development of a brain or central nervous system that covers a large spectrum of impairment, symptoms and skills. The children who are suffering from autism face difficulties in communicating and adapting well in the community as they have trouble in understanding what others think and feel. However, children with learning disabilities appeared to have significant strengths in visual-spatial intelligence as they do the best when they deal with inductive learning and problem solving. This paper proposed a game-based learning application for autism children using visual spatial approach. Furthermore, this research aim is to provide a fun, interactive and engaging digital platform for learning basic knowledge such as alphabets, shapes and colors by using puzzle technique in manner it could cultivate interest in autism children as well as improvise social development. Several methods such as observation and references were used in the study. On the other hand, pilot test was conducted on 5 selected students from National Autism Society of Malaysia (NASOM) Melaka to identify the most suitable content in design and gameplay which can be developed to be compatible with autistic characters as well as to enhance their social skill and cognitive progress in future. Observation was conducted to understand their behavior in game engagement and obtain feedback of their needs and learning goals. Furthermore, the findings attached to the understanding that most of the respondents are impacted to the game play and fascinated with each element used in game design. Thus, the game prototype developed using visual spatial approach can slightly stimulate their social abilities and encourage children with autistic disorder to kindle a wide spectrum of skills. Moreover, future research is required to determine other factors contribute to the development of social and cognitive abilities for individuals with ASD.**

Author Keywords: *Autism Spectrum Disorder; Visual Spatial Approach; Game Based Learning; Social Development*

1. INTRODUCTION

Autism disorders' severities are broad, which includes impairments in social interactions, difficulties in communication, cognitive delays and behavioral problems that include restricted interests and repetitive behaviors [1]. According to Centre for Disease Control and Prevention (2010), autism is a developmental disorder that affects 1 out of every 110 children [2]. Meanwhile, the Malaysian Ministry of Health came out with the ratio of one of 600 children in Malaysia is autism based on the latest statistic [3]. Statistically 47, 000 people in Malaysia were diagnosed as autism and the number is expected to increase every year [3]. It is also estimated that four out of every 10,000 suffer from severe autism [3]. The signs of autism are observed in the early years of a child's life. Children who are suffering from autism face difficulties with social interaction and not adaptive well in the community as they have trouble in understanding what others think and feel. Due to this fact, their learning ability and mental development may be quite slower than normal children. Unfortunately, previous researches identified particularly many of them especially Asperger's Syndrome still have outstanding capability [4]. Memory, visual spatial concept, puzzles, graphic design and music are characterized as common autistic children's intelligences [5].

Furthermore, playing is important in child development stage. Children learn through playing games, interact with others and integrate into society. However, autistic children cannot learn social identification compare to normal children. Therefore, this study takes Gardner's theory as a root to investigate the potential of designing a digital learning game for autistic rehabilitation [6]. Despite on this fact, their learning and social ability could be improvised using digital technology and interactive game design. Moreover, using flexible and interactive teaching aid would encourage enjoyable learning process and allows the autistic children to gain more and experience the real scenario through the implemented approach. Hannaford (1983) indicated that using computer in special education have the following advantages, individualization, enhancement of learning motivation and interests, and instant feedback [7]. Previous researches also provide evidence that digital technologies can be applied to autistic children, who can be benefited by digital tide without any barrier. One of the strongly recommended approaches for teaching autistic children is visual aid as it provides a safe, secure, and less anxious environment for autistic users [8]. In fact, computer provides multisensory incentive such as colorful display and lively sound to attract students 'attention, enhance learning motivation and performance [9]. Keeping this in view, this study was conducted to proposed game-based learning prototype using visual spatial approach.

According to Keith (2008), many children with learning disabilities appeared to have significant strengths in visual-spatial intelligence [10]. This implies that to teach underachieving students, teachers should capitalize on visual-spatial intelligence by using many pictures, diagrams, courseware rich with graphics,

videos, and printed materials full of graphics [10]. According to Sternberg (1990), one's spatial ability pertains with the visualization of shapes, rotation of objects, and how pieces of a puzzle would fit together [11]. Likewise, Linn and Petersen (1985) indicated the skills in re-presenting, transforming, generating and recalling symbolic and nonlinguistic information are associated with this ability [12]. Due to this fact, this research aim is to provide a fun, interactive and engaging digital platform for learning basic knowledge such as alphabets, shapes and colors by using puzzle technique in manner it could cultivate interest in autism children as well as improvise their social skills, emotion and cognitive development. In this paper, we discuss the steps taken in conducting this pilot study on 5 children with ASD. We also discuss the outcome of this study and the overall reaction of the students.

2. METHODOLOGY

This research includes three stages of methodology as follows. The game content and interface design were developed based on data collections such as preliminary study on autism characteristics and visual spatial mechanism approach, the interview session and from site observation.

2.1 Step 1: Interview with therapists and parents

Several interviews with parents and therapists were needed to find out the limitations and characteristics of children with ASD. The result of the interviews helped us to classify the students based on their problems and understand their talents and skills. Children with ASD have a strong attachment to some substances, interview with their parents helped guide us to identify these substances to ease our process of experiment.

2.2 Step 2: Site Observation

Site observation was used in the study to understand autistic children's behavior in game engagement and obtain feedback of their needs and learning goals. Researcher at first had a session with the autistic students aged 6 to 8 years old to personally observe their behavior and learning process as well as identifying conventional teaching aids used by each therapist in the class before researcher start to observe the students' understanding on the game prototype.

2.3 Step 3: Pilot Test

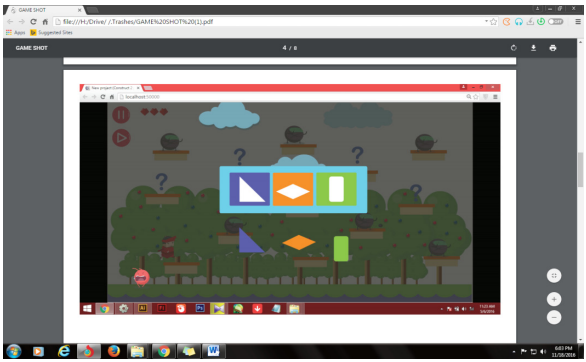
The final stage is to test the acceptability and potential of the game applied to autism rehabilitation through user testing between the children with ASD and their therapists. For the game prototype, researcher attempts to promote unique interface design which indicates the Malay identity in its character design and

the environmental design as well. The pilot test was conducted in two sessions among 5 selected students from National Autism Society of Malaysia (NASOM) Melaka to investigate its acceptability and potential in autism rehabilitation. From this stage, the researcher intends to identify the most suitable content in design and gameplay which can be improved later on to be compatible with autistic characters as well as to enhance their social skills and cognitive progress in future.

3. FINDINGS AND DISCUSSION

From the interview session, researcher interviewed 5 parents and 2 therapists in two separate sessions to help the researcher find out the limitations and problems. The researcher managed to get a better insight into the likes and dislikes of 5 autistic children. Based on the initial study from interview session with therapists, researcher found out the children are interested to be rewarded if they complete any task. Same goes to parents, they agree on the fact that their children love to be rewarded to encourage and motivate them finishing a task especially a simple homework. The parents also claim their children much prefer to play with gadgets. Furthermore, the therapists informed that children with ASD are easy to get frustration and tantrum if they got less motivation or supports. Furthermore, from the site observation, researcher identified several teaching aids used to help the children with ASD in class. Basically, the children are clustered based on their level of understanding and ages. For children aged 6 to 8 years old, the therapists used conventional methods such as colorful sticks, blackboard, balls and puzzles to stimulate their cognitive and motor skills. In rehabilitation process, therapists also scheduled several creative activities for the children such as coloring session, handprint art and cut-paste activities. However, it is difficult for therapist to engage an autistic child to attend in the whole therapy session because sometimes children refuse to finish the session as they cannot concentrate for a long period of time, they feel uncomfortable or their emotion is unstable.

From the pilot test session, therapists help the children and sat with them to play the game for a few minutes before they became engaged in the game. Manual instruction for the game play is provided to help therapists to guide students during the pilot test. Moreover, therapists also help the researcher in monitoring the students' rehabilitation progress and their feedback on this digital approach within two weeks periods of time. Finally, the finding is presented in the following Table 1 with the evaluation result of each child during pre-pilot test and post pilot test.



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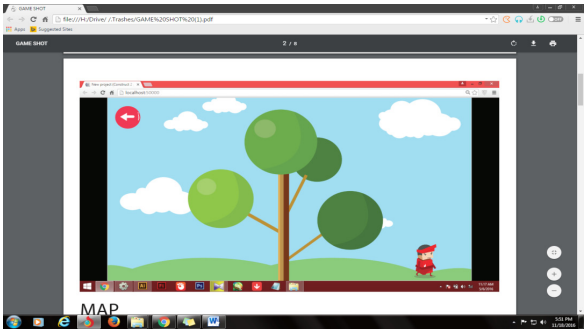

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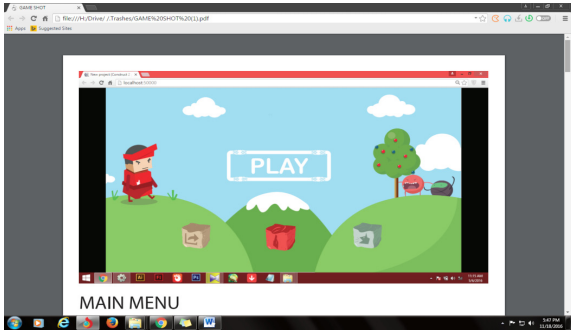

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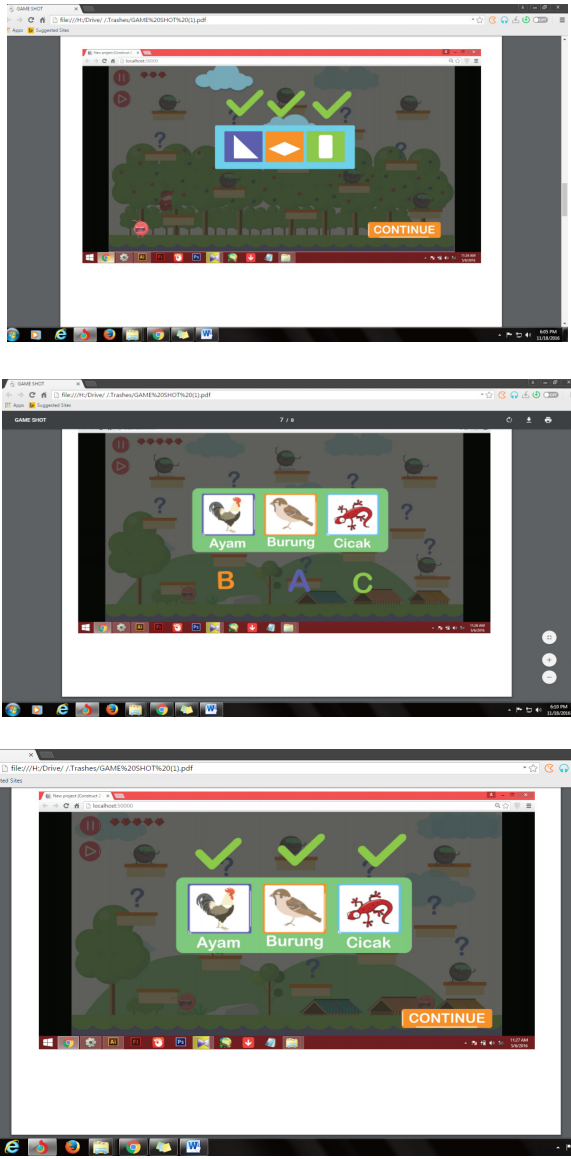

Fig. 1: Game Interface Design

Fig. 2: Pilot Test Session

Table 1: Evaluation Results on Pilot Test Session

No	Participants	Pre Pilot Test	Post Pilot Test
1	Students A	He did not know how to control the mouse for the first time. He took the therapist's / teacher's finger and put it on the mouse to help him for the first session for each level and getting to know of how to complete the levels. He seems struggling when trying to finish each level.	He can control the mouse, understand the game flow and complete the task without help. He was very interested to see applause character as a reward, for each level he knew he had to play well so that he could get rewarded.
2	Students B	She was very good in finding correct answer by moving an object to another similar object in few minutes. In some complex environments, she was a bit confused and clicked on other objects but immediately found the correct answer.	She was sharp and totally engaged in the game. She was really happy and motivated in every session and asking her teacher twice to repeat the game.
3	Students C	He was a very hyper active student. He enjoyed only pressing random keyboard and clicking the mouse repetitively on the objects. He could not continue playing the game because he said the game is too hard.	He could not comprehend any object or puzzle in the game. He was extremely hyper active. He seems not interested and lost focus with the game.
4	Students D	Before he started playing, he was quite confused on how to control the mouse and keyboard at one time to move the character, only then after getting helped and instructed by his teacher, he slowly pressing the keyboard and clicking the mouse to finish the task. He was not adventurous like the other boys, he did not try to click on every question provided and he cannot understand too much on the instruction given by his teacher.	He was quite a slow learner because he able to use only one control key to complete the task. However, he became interested after being rewarded for completing the first level.

5	Students E	Before he started playing, he tried to explore the game and asking his teacher continually on how to play the game. He was quite active and interested to complete the game but hard to handle with two control keys at the same time.	He gradually became better and more independent. He was extremely enjoying the game and he was interested in rewards every time he completed the task.

From Table 1, the finding attached to the understanding that most of the students are impacted to the game play and fascinated with each element used in game design. Unfortunately, some of the students feel harsh to use multiple control keys such as mouse and keyboard in one time to play the game. They prefer to use single control key either pressing keyboard (arrow key) or using mouse control to stay focus and engaged. Furthermore, most of the students are highly motivated with the rewards given on each level if they successfully complete all tasks. Most of the students enjoy playing the game after two sessions of pilot test and being monitored frequently by their therapists.

4. CONCLUSION AND FUTURE WORK

In conclusion, the researcher found that the game prototype developed using visual spatial approach helped the children to slightly stimulate their social abilities and encourage them to kindle a wide spectrum of skills. Autistic children love to be rewarded every time they complete a task because by rewarding them, it will build up their confidence level as well as improvise social skills. Children with ASD find it hard to concentrate for a long period of time, but when they are visually engaged, they are motivated and encouraged to do extremely well. Children with autism can improve their condition and assist in their quality of life with some help from practices and therapies. The computer game has been proven as a powerful device to help children with autism and teach them new skills. On the other hand, the researcher plan to extend this research further by including digital storytelling, improve the limitation by setting into a single control key either using keyboard or mouse control, or switch into mobile apps to engage these special children. The concept of reward and Malay identity will be a focal point. Moreover, future research is required to determine other factors contribute to the development of social and cognitive abilities for individuals with ASD.

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